U. S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Vetericaris chaceorum*

COMMON NAME: Anchialine pool shrimp

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: September 2005

STATUS/ACTION:

_____ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, we did not elevate it to Candidate status

____ New candidate

__X_ Continuing candidate

____ Non-petitioned

__X_ Petitioned - Date petition received: May 11, 2004

____ 90-day positive - FR date:

_X__ 12-month warranted but precluded - FR date: May 11, 2005

_N__ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)?

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions?

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

__X_ Listing priority change

Former LP: __1_

New LP: __4_

Date when the species first became a Candidate (as currently defined): 10/25/1999

____ Candidate removal: Former LP: ____

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Crustaceans; Family Procarididae (anchialine pool shrimp)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

LAND OWNERSHIP
Lua o Palahemo occurs on State land which is administered by the State of Hawaii DHHL.

LEAD REGION CONTACT: Paul Phifer (503) 872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE: Pacific Islands Fish & Wildlife Office, Lorena Wada (808) 792-9400, lorena_wada@fws.gov

BIOLOGICAL INFORMATION:

Species Description: Total length is approximately 5.0 centimeters (2 inches), not including the primary antennae which are approximately the same length as the shrimp's total length. Based on a number of morphological characters, this genus is considered primitive (Kensley and Williams 1986). In limited observations, *Vetericaris chaceorum* was observed to swim in midwater, never being stationary on the substrate. The shrimp uses its primary thoracic appendages (pereiopodal exopods) as well as its abdominal appendages (pleopods) for propulsion in a forward direction (Kensley and Williams 1986). Use of tail-beats for backward propulsion was never observed. Large chelapeds (claws) are lacking. While gut contents included fragments of other crustaceans, no feeding has been observed and it is not known if this

species is a predator, scavenger, or both (Kensley and Williams 1986).

Taxonomy: *Vetericaris chaceorum* is a monotypic genus that was originally described by Kensley and Williams in 1986. The US Department of Agriculture's Integrated Taxonomic Information Systems online database considers the taxonomy of this species to be valid and this species is recognized as a valid taxon in MacLauglin *et al*. (2005).

Habitat: Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean (Maciolek 1983). They are mixohaline, with salinities ranging from 2 parts per thousand (ppt) to concentrations just below that of sea water (32 ppt) (Brock *et al*. 1987). Anchialine pools are typically subject to tidal fluctuations. Except for some records of endemic eels, anchialine pools do not generally support native species of fish although some species of nonnative fish have been introduced and are currently recognized as problems (Bailey-Brock and Brock 1993; Brock 2004). Although anchialine pools are widespread, being found in areas such as Saudi Arabia, Madagascar, Fiji, and other Indo-Pacific islands, the total area occupied by them globally is extremely small (Maciolek 1983). While a number of species of anchialine shrimp (e.g., *Anticaridina lauensis, Calliasmata pholidota*) have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983).

Historic and Current Range/Distribution: *Vetericaris chaceorum* has only been reported from a single location, Lua o Palahemo, on the island of Hawaii (Hawaii Natural Heritage Program database 2004). Unlike most anchialine pools in Hawaii, which are no more than a few meters in depth, Lua o Palahemo is a lava tube which reaches a depth of nearly 40 meters (m) (131 feet(ft)) and extends for a submerged, subterranean length of nearly 300 m (984 ft) (Kensley and Williams 1986). Salinities within this single pool range from 20 ppt at the surface to 30 ppt at its deepest, most seaward location. Dissolved oxygen was recorded to range from 6.0 parts per million (ppm) at the surface to 0.3 ppm at the deepest sample station (Kensley and Williams 1986).

As well as being very restricted in range, relatively few individuals were encountered in the last survey (1985) for this species by Kensley and Williams (1986). There were only five detections of *Vetericaris chaceorum* during three separate dives (Kensley and Williams 1986). Other than a recent site visit in 2005 there have been no population surveys for this species since 1986 (R. Brock, pers. comm. 2004). Like other anchialine pool shrimp species, it is believed that this species inhabits an extensive network of water-filled interstitial spaces (cracks and crevices) leading to and from the actual pool (the Lua o Palahemo lava tube system), and this trait has precluded researchers from obtaining more accurate population size estimates (R. Brock, pers. comm. 2004). It has not been observed in other anchialine pools anywhere in Hawaii; this highly restricted range, in conjunction with the potential threats and lack of protection, make this species highly vulnerable (R. Brock, pers. comm. 2004). *Vetericaris chaceorum* co-occurs with three other candidate species of anchialine pool shrimp, *Calliasmata pholidota, Procaris hawaiana,* and *Antecaridina lauensis* (Holthuis 1973; Maciolek 1983; Brock 2004)

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Development of coastline areas has been responsible for the destruction or degradation of anchialine pools on all of the Hawaiian Islands (Bailey-Brock and Brock 1993). Brock (2004) estimates that up to 90 percent of the pools on the island of Hawaii may have been destroyed by such activities or by the introduction of nonnative fish into anchialine pools. The South Point area of Hawaii, or Ka Lae, has been utilized as ranch land (Kahuku Ranch) for over a century, hence, land uses have greatly altered the terrestrial habitat. Lua o Palahemo now lies within lands administered by the State of Hawaii Department of Hawaiian Home Lands (DHHL). Since European contact, human use of this anchialine pool, including dumping of refuse, has degraded this habitat (R. Brock, pers. comm. 1998, 2004).

B. Over-utilization for commercial, recreational, scientific, or educational purposes. *Vetericaris chaceorum* has been collected, on a very small scale, for scientific/educational purposes on only a few occasions. While there is no record of collection of this species for commercial or recreational purposes, the Service has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (www.eco-sphere.com 2004). One company located in Hawaii, FukuBonsai, has already begun using Hawaiian anchialine pool species for the aquarium hobby market (wwwfukubonsai.com 2004). For commercial purposes, currently only a State Commercial Marine License is required to collect anchialine pool shrimp. The Service believes this particular species is not likely to be among those species collected for trade and business due to the difficulty in collecting them. Unlike the other Hawaiian anchialine pool shrimp species, collecting *Vetericaris chaceorum* may require involved dives with the use of scuba equipment.

C. Disease or predation.
In Hawaii, predation by introduced nonnative fish is considered to be the greatest threat to native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993; Brock 2004). Marine fish are occasionally seen in isolated pools, indicating that people are introducing these fish into the pools (Bill Evanson, Hawaii Department of Land and Natural Resources, pers. comm. 1998). Anchialine pools have been used to discard or hold bait-fish and/or aquarium fish (Bailey-Brock and Brock 1993). These fish either directly consume the native shrimp or, as with introduced tilapia (*Oreochromis mossambica*), out-compete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp. Introduction of nonnative fish including bait-fish into such pools may have been a major contributor to the decline of these shrimp. No alien fish species were seen during the most recent visit to the pool where *V. chaceorum* occur (Mike Richardson USFWS, pers. comm. 2005).

Invasion, with human assistance, of anchialine pools by nonnative fish is a potential threat, disturbance of the pools is prohibited and informative signs have been placed at the sites. However, there are concerns that this may not be adequate protection. For example, since

1985 signage was used to keep people from entering the Waikoloa Achialine Pond Preserve at Waikoloa, North Kona, Hawaii. Visitors were not allowed into the pool preserve but could walk around the perimeter. In December of 2003, it was discovered that someone had released tilapia and mosquito fish into the system. Within six months time, two thirds of the system had been invaded by the alien fish and all the anchialine pool shrimp disappeared (Brock 2004). The threat of invasion of nonnative fish to Lua o Palahemo where *V. chaceorum* occur is great since is it easily accessible to the public.

D. The inadequacy of existing regulatory mechanisms.
There are no existing regulatory mechanisms that specifically protect this species other than the requirement of possessing a State Commercial Marine License prior to its collection from the wild.

E. Other natural or manmade factors affecting its continued existence.
Even if the threats responsible for the decline of this species were controlled, the persistence of its one existing population is hampered by the small geographic range of the known population. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small or single populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Center for Conservation Update 1994). Small or single populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio (Lande 1988).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED
No conservation agreements between Federal or State agencies have been drafted or initiated and no conservation management activities have been conducted.

SUMMARY OF THREATS
The primary threats to this species are the loss of habitat due to degradation and predation from nonnative fish. There are no conservation efforts underway to alleviate the potential for any of these threats.

SUMMARY OF REASONS FOR ADDITION, REMOVAL OR LISTING PRIORITY CHANGE
We have changed the LPN for this species from a 1 to a 4 because on the last visit to the pool, no nonnative fish were seen in the pool.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

High	Imminent	Monotypic genus Species Subspecies/population	1 2 3
	Non-imminent	**Monotypic genus** Species Subspecies/population	**4*** 5 6
Moderate to Low	Imminent	Monotypic genus Species Subspecies/population	7 8 9
	Non-imminent	Monotypic genus Species Subspecies/population	10 11 12

Rationale for listing priority number:

Magnitude:

Threats to *Vetericaris chaceorum* are range-wide and therefore of high magnitude as this species occurs in only one pool. *Vetericaris chaceorum* may potentially be threatened by degradation and destruction due to dumping or fill, or from recreational activities. The introduction of nonnative fish (often with human assistance) is an ever present threat and collection of *Vetericaris chaceorum* for sale or trade is also a potential threat to this species.

Immediacy:

The primary threat to this species from nonnative fish is non-imminent because currently there are no fish in the pool. There were no signs of dumping or fill on a site visit in early 2005, although dumping had been previously reported (R.Brock, pers. comm. 2004).

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?

No. The species does not appear to be appropriate for emergency listing at this time because nonnative fish do not occur in the pool and there were no signs of dumping or fill on a recent site visit. It is believed the primary habitat these shrimp inhabit are tiny (inaccessible to humans and most fish) cracks and crevices within the lava rock. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *Vetericaris chaceorum* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING:

We conducted literature searches for recent articles on this species and contacted relevant species experts, the U.S. Geological Survey-Biological Resources Discipline, State officials with the Department of Land and Natural Resources, and Bishop Museum, University of Hawaii, and Auburn University researchers regarding the current status of this species. Additional information on the species' status was added to this update and the existing data regarding the species' status was verified.

This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted as well as relevant species experts contacted. Information contained in this assessment form was verified by species experts and new information incorporated. The Hawaii Biodiversity and Mapping Program lists this species as critically imperiled (Hawaii Biodiversity and Mapping Program database 2004). This species is not listed in the International Union for Conservation of Nature and Natural Resources Red Data List database (International Union for Conservation of Nature and Natural Resources database 2004).

List of Experts Contacted:

Name	Date	Place of Employment
Richard Brock	July 13, 2005	University of Hawaii
Ronald Englund	July 12, 2005	Bishop Museum
David Foote	July 12, 2005	U.S. Geological Survey, BRD
Betsy Gagne	July 12, 2005	Hawaii Dept of Land and Natural Resources
Thomas Iwai	July 13, 2005	Hawaii Dept of Land and Natural Resources
Michael Kido	July 12, 2005	University of Hawaii
Cedric Muir	July 14, 2005	University of Hawaii
David Preston	July 12, 2005	Bishop Museum
Atlantis Russ	July 14, 2005	University of Hawaii
Scott Santos	July 12, 2005	Auburn University
Michael Yamamoto	July 13, 2005	Hawaii Dept of Land and Natural Resources

List of Databases Searched:

Name	Date
Hawaii Biodiversity and Mapping Program [Hawaii Natural Heritage Program]	2004
International Union for Conservation of Nature and Natural Resources	2004
Integrated Taxonomic Information System	2005

COORDINATION WITH STATES

In October 2004 we provided the Division of Forestry and Wildlife Administrator, Paul Conry, with copies of our most recent candidate assessment forms for his review and comment. In addition, copies of the candidate forms were sent to Betsy Gagne, Executive Secretary for the Hawaii Natural Area Reserves System Commission. Ms. Gagne reviewed the information for this species and provided no additional information or corrections (B. Gagne, pers. comm. 2005).

LITERATURE CITED

Bailey-Brock, J.H. and R.E. Brock. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp *Halocaridina rubra* (Atyidae). Pacific Science 47:338-355.

Brock, Richard. 1998. University of Hawaii at Manoa. Personal communication.

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Brock, R.E., J.E. Norris, D.A. Ziemann, and M.T. Lee. 1987. Characteristics of water quality in anchialine ponds of the Kona, Hawaii, coast. Pacific Science 41:200-208.

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Kensley, B. and D. Williams. 1986. New shrimps (families Procarididae and Atyidae) from a submerged lava tube on Hawaii. J. Crustacean Biol. 6: 417-437.

Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). Oecologia 75: 601-607.

Maciolek, J.A. 1983. Distribution and biology of Indo-pacific insular hypogeal shrimps. Bulletin of Marine Science 33:606-618.

McLaughlin, P.A., D.K. Camp, M.V. Angel. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31. Bethesda MD, USA. 545pp.

Www.eco-sphere.com. (website) 2004.

Www.fukubonsai.com (website) 2004.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Acting _____ 11/16/05
Regional Director, Fish and Wildlife Service Date

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: _____
Conducted by: Lorena Wada, Pacific Islands FWO

Comments:

PIFWO Review
Reviewed by: Christa Russell Date: 10/6/05
Acting Assistant Field Supervisor, Endangered Species

Patrick Leonard Date: 10/11/05
Field Supervisor